

APPENDIX H
SALT MARSH HABITAT RESTORATION PLAN

Salt Marsh Habitat Restoration Plan

(Revision #3)

**Moffett Field Naval Air Station
Installation Restoration Site 25
Mountain View, California**

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TABLE OF CONTENTS

1.0 INTRODUCTION 1

 1.1 BIOTIC RESOURCES..... 1

 1.2 EXISTING HABITAT 1

2.0 RESTORATION PLAN 2

 2.1 AREAS OF DISTURBANCE AND RESTORATION 2

 2.2 FILL MATERIAL 2

 2.3 PLANT MATERIAL SALVAGE AND PROPAGATION 2

 2.3.1 *Recommended Timing of Propagule Harvest and Propagation*..... 3

 2.3.2 *Field Verification of Impact and Revegetation Areas*..... 3

 2.4 RECOMMENDED PROTECTIVE MEASURES DURING PROPAGULE COLLECTION & CONSTRUCTION..... 5

 2.5 EXOTIC PLANT CONTROL 5

 2.6 PLUG PLANTING..... 6

 2.7 IRRIGATION..... 6

3.0 MAINTENANCE & MONITORING 6

 3.1 MAINTENANCE 6

 3.2 MONITORING AND PERFORMANCE CRITERIA 7

 3.2.1 *Photo-documentation* 7

 3.2.2 *Percent Cover Monitoring* 7

 3.2.3 *Monitoring Reports* 7

4.0 REFERENCES..... 9

Table 1 – Restoration Areas & Native Plant Materials List

Table 2 - Monitoring & Performance Criteria

Attachments – Re-Vegetation Plan Map

1.0 INTRODUCTION

This Habitat Restoration Plan (Plan) has been prepared for Installation Restoration Site 25 (IR Site 25) at the former Naval Air Station Moffett Field, Mountain View, California. It describes the methods and techniques to re-establish native vegetation within impact areas approximately to pre-existing salt marsh conditions. The planned remedial action includes excavation and removal of surface soils contaminated with lead, zinc, dichlorodiphenyltrichloroethane (DDT), and polychlorinated biphenyls (PCBs) from predetermined Thiessen polygons throughout the site.

Soil remediation polygons exist in the Eastern Diked Marsh, NASA Stormwater Retention Basins (Northeast and Central), and in the Midpeninsula Regional Open Space District (MROSD) areas of the site. As part of the remedial action, native and non-native vegetation will be removed and clean fill soils will be placed within the removal area following excavation and off-haul of the contaminated sediments. Where not inundated, these fill soils will be re-vegetated with select salt marsh vegetation to the pre-construction condition within the MROSD and Central NASA Stormwater Retention Basin. The inundated areas of the MROSD and NASA Stormwater Retention Basins will not be revegetated, nor will the Eastern Diked Marsh, which will be backfilled only after remedial activities are complete.

Revegetation of salt marsh will be accomplished by salvaging native plant material from the site prior to remediation activities, propagating the plants at an off-site nursery, and returning the plants to the site for installation within appropriate impact areas. It should be noted that exact locations and extents of impact areas and inundated areas are poorly defined as of the date of this report and will likely be subject to change in the field.

1.1 Biotic Resources

A Biological Resources Assessment (BA), dated January 2011 was prepared for the proposed project by Ardea Consulting et.al. The BA identified the following federally listed wildlife species that potentially could occur within or immediately adjacent to the project area:

Federally Listed

- California clapper rail (*Rallus longirostris obsoletus*)
- California least tern (*Sternula antillarum browni*)
- Western snowy plover (*Charadrius alexandrinus nivosus*)
- Salt-marsh harvest mouse (*Reithrodontomys raviventris*)
- California seablite (*Suaeda californica*)

In addition, 23 other State listed species were identified in the BA as having the potential for occurrence at the site. Additional information can be found in the BA (Ardea et. al., 2011).

1.2 Existing Habitat

Much of the site consists of two distinct habitats: seasonally flooded mudflats with little or no emergent vegetation and salt marsh wetland areas. All areas have been isolated from the bay and are not subject to tidal influence. The dominant species within the salt marsh include pickleweed (*Salicornia virginica*) and salt grass (*Distichlis spicata*). Cattails (*Typha* sp.), marsh baccharis (*Baccharis douglasii*), and spearscale (*Atriplex triangularis*) are also found within the site. The brackish eastern-diked marsh contains scattered remnants of creeping wild rye (*Leymus tricoides*), rush (*Juncus* sp), California tule (*Scirpus californica*), and willows (*Salix* sp.)

Native vegetation is compromised by a multitude of non-native plants at the site, some of which are highly invasive. Dominant non-native plants that occur include iceplant (*Carpobrotus edulis*), fennel (*Foeniculum vulgare*), purple star thistle (*Centaurea calcitrapa*), yellow star thistle (*Centaurea*

solstitialis), and pampas grass (*Cortaderia jubata*), plus a host of other thistle, perennial grass, introduced trees, and shrub species. Most of these invasive, non-native species are confined to the littoral zone and the uplands along the flanks of the dikes and access roads.

2.0 RESTORATION PLAN

2.1 Areas of Disturbance and Restoration

The proposed project entails the excavation and removal of 6-18 inches of contaminated sediments, replacement, and compression of clean fill within select Theissen polygons found within the Eastern Diked Marsh, NASA Storm Water Retention Basins (Northeast and Central), and MROSD property. However, only the areas shown on the Re-Vegetation Plan Map within MROSD and the Central NASA Storm Water Retention Basin are proposed for revegetation. Per communication with NASA, the Eastern Diked Marsh will be backfilled after remedial excavation, but will not be revegetated. In addition, although some upland and littoral areas will be disturbed by remedial activities, only seasonally dry salt marsh areas are proposed for revegetation. Areas of salt marsh that are inundated year round will not be revegetated. Disturbance and restoration areas associated with all three zones are shown on the Re-Vegetation Plan map (attached).

2.2 Fill Material

Restoration success within salt marsh areas will be partially dependent on the quality of fill material that is placed within the remedial excavations. This material must be of similar texture and composition to the adjoining salt marsh sediments to ensure consistent hydrological and sediment conditions across the restoration site as well as an appropriate growing media for the native salt marsh plants. In general, pickleweed grows well in fine, silty soils that contain <30% sand and 10-40% organic matter, and lie within a salinity range of 10 to 90 parts per trillion (ppt) (Griffith, 2010). In addition, fill material must be free of detectable concentrations of contaminants and should be of a neutral or slightly alkaline pH, if possible.

In order to verify that the on-site borrow material is capable of supporting pickleweed, an assessment of the borrow site soils will be performed. Samples of the borrow area will be collected, as will samples of sediment from an uncontaminated area with pickleweed stands. Comparative tests will be run for the following parameters: particle size distribution; agricultural constituents including available nutrients and salts; pH, organic matter; metals including trace metals (Cu, Zn, Fe, Mn, B) and toxic metals; biochemical oxygen demand (BOD); and chemical oxygen demand (COD).

2.3 Plant Material Salvage and Propagation

The native plant species selected for restoration purposes have been chosen based on their presence within the areas of disturbance and adjoining areas, ease of propagation, ability to compete with weeds, and effectiveness at providing habitat value for the wildlife known from the site. Propagules of the plants listed in **Table 1** below shall be collected on site prior to the initial vegetation removal activities and propagated at an off-site nursery. Propagules will be collected from uncontaminated areas if possible. However, if propagules are harvested from contaminated sediments, any soil on the root mass of plants and divisions harvested shall be rinsed off using water and left onsite in a shallow basin at the excavation site or other location as directed by the remediation contractor. Horticultural cultivars of these species are not acceptable for restoration purposes. Plant names, spacing, quantities, and container types are listed below in **Table 1**.

2.3.1 Recommended Timing of Propagule Harvest and Propagation

The ideal collection time for these salt marsh species is typically during mid-late summer or early fall, prior to dormancy. Restoration success is achieved by using plant material that is healthy and well rooted but not pot-bound. Therefore, it is recommended that salt marsh species be harvested from the site at least 8 months prior to remedial excavation and backfilling activities to allow for adequate propagation time at the off-site nursery. For example, if revegetation is planned for summer 2012, then propagule harvest should ideally occur during fall 2011.

2.3.2 Field Verification of Impact and Revegetation Areas

As previously stated, this Plan was prepared without the benefit of precise locations of impact and revegetation areas and the relative coverage of pickleweed and saltgrass within those areas. As such, the relative numbers of pickleweed versus saltgrass plugs cannot be accurately determined and the exact impact/planting area cannot be delineated as of the date of this report. The goal of the restoration is to restore vegetation to its approximate pre-existing condition. Therefore, prior to the propagule harvesting event for the off-site nursery, the propagation contractor shall meet with the remediation contractor in the field to review their workplan and the precise locations of impact and appropriate restoration areas. This field visit will provide the additional information required to determine an accurate ratio of pickleweed to saltgrass plugs necessary for harvest and propagation.



Photo 1 - Pickleweed propagation in 6-inch leach tubes (“stubbies”)

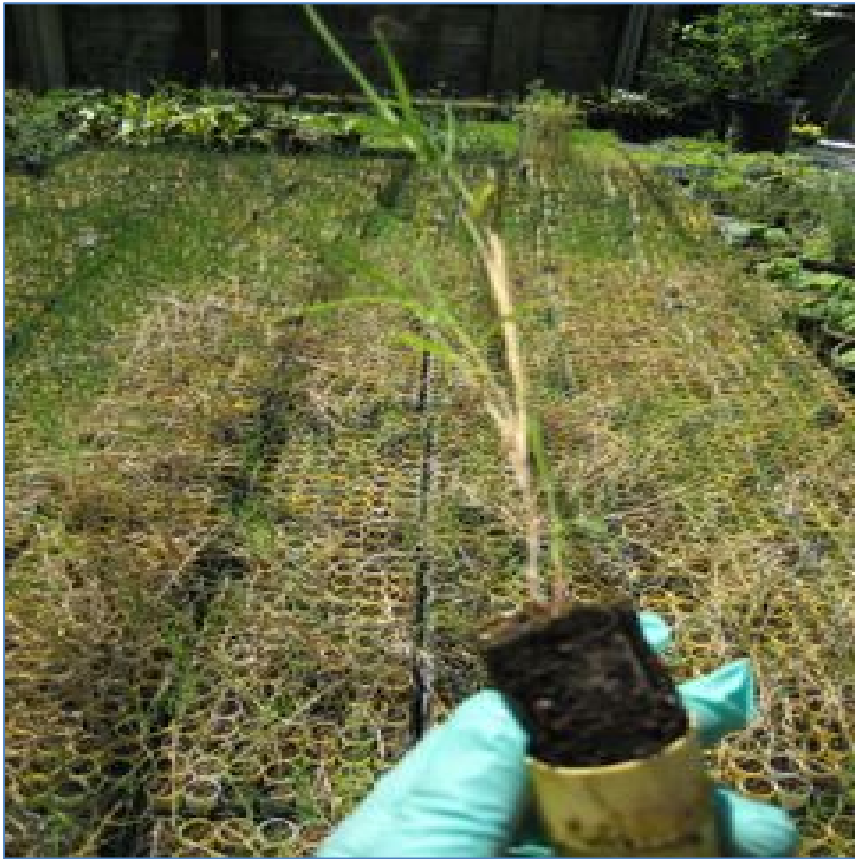


Photo 2 - Salt grass propagation in 6-inch leach tubes (“stubbies”)

Table 1 – Restoration Areas & Native Plant Materials List

Central NASA Stormwater Retention Basin – Summary of Impact & Restoration Areas

Vegetation Type:	Estimated Areas of Impact* (sq. ft.):	Plant Spacing:	Plant Quantities:*
Pickleweed & Salt grass	250,000	3'O.C.	27,778 plugs
TOTAL:			27,778 plugs

MROSD - Summary of Impact & Restoration Areas

Vegetation Type:	Estimated Areas of Impact* (sq. ft.):	Plant Spacing:	Plant Quantities:*
Pickleweed & Salt grass	103,000	3'O.C.	11,444 plugs
TOTAL:			11,444 plugs

Notes:

O.C. = On center

Plug = 6-inch leach tube (“stubby”)

N/A = Not applicable

SF = Square feet

* Impact areas and corresponding plant quantities shown in the above tables are based on an estimate of feasible restoration areas determined by a review of mapped wetland and seasonally flooded mudflat areas. They are NOT based on the area information provided in the original S.O.W. tables or any other construction plans, which were not available at the time of this report. Restoration areas designated on attached map are diagrammatic and are not to be taken literally, actual impact and planting areas should be field verified by contractor prior to plant salvage for off-site propagation. Ratio of pickleweed to saltgrass and corresponding plant quantities also to be field verified with contractor prior to plant salvage for off-site propagation.

2.4 Recommended Protective Measures During Propagule Collection & Construction

Due to the irregular spaced and shaped excavation polygons, construction and access activities have the potential to impact existing vegetation in areas not targeted for excavation of sediment. The contractor crew shall be briefed on the importance of the native vegetation and will limit the disturbance of areas of native vegetation outside the remedial excavation areas. Collection and harvesting of plant material on site shall be conducted prior to the initial vegetation removal process, which shall be performed in compliance with the avoidance measures as specified in the BA (Ardea, et.al. 2011). As specified in the BA, a qualified biologist shall be present during vegetation removal/harvesting activities to monitor for the presence of the salt-marsh harvest mouse.

2.5 Exotic Plant Control

Some of the construction activities, especially around the margins of the salt marsh and along the upland dikes, will occur in areas that are populated with non-native plants. During construction, any non-native plants that are removed shall be temporarily stockpiled on site prior to disposal at the municipal landfill. Non-native plants shall not be placed back in the restoration areas.

After excavation, it is recommended that any remaining non-native plants (as specified) within the work area be controlled by a 2%-5% solution of glyphosate specified for use near wetlands (Rodeo[®]), where hand pulling or equipment use is not practical or permitted. Rodeo[®] is to be applied when plants are actively growing but prior to seed maturity. Herbicide use shall occur on days when measurable precipitation is not forecasted and wind is <5 miles per hour. Herbicide application shall be performed by a qualified applicator and shall not occur within 10 feet of standing water resources. Non-native plants treated with herbicide may be left in place to decompose.

If herbicide use is not acceptable, or for smaller infestations, non-native plants will be controlled by hand pulling and off-site disposal. In any case, herbicide use should be minimized whenever practical. The plants that are of highest priority for control include the following: Italian thistle (*Carduus pycnocephala*), iceplant (*Carpobrotus edulis*), fennel (*Foeniculum vulgare*), purple star thistle (*Centaurea calcitrapa*), yellow star thistle (*Centaurea solstitialis*), and pampas grass (*Cordaderia jubata*). Invasive plants that may invade salt marsh habitats shall also be controlled, especially smooth cordgrass (*Spartina alterniflora*). Non-native annual grasses in upland areas will not be controlled. Weed control shall continue periodically during the entire 2-year establishment period in order to promote successful establishment of the installed native plant material.

2.6 Plug Planting

Planting shall occur after excavation and clean fill placement activities are completed. As stated in the BA (Ardea et. al., 2011), it is assumed that planting will occur sometime between May 1 and November 30. Planting of pickleweed and saltgrass should occur during this approximate time period but before significant rainfall has occurred, which will increase the extent of saturated soils in the low-lying marsh areas. Whenever possible, planting should occur when soils are moist, but not saturated. Use of a dibble for planting in softer soils will minimize the amount of spoils created by the planting process. In any case, after digging a hole approximately 8-inches deep, plants shall be removed from their containers and placed immediately in the planting hole, taking care not to disturb the roots. Each planting hole shall be backfilled and gently compressed with the fill soil, taking care to leave the crown of the plant even with or slightly above the soil surface. Plugs of pickleweed and saltgrass shall be planted at an approximate spacing of 3 feet on center.

2.7 Irrigation

Planting shall occur during late fall/early winter. No supplemental irrigation is anticipated in the low-lying marsh areas.

3.0 MAINTENANCE & MONITORING

Maintenance and monitoring activities will be performed as a separate task from propagation and initial restoration. Each maintenance and monitoring task is described below in the following sub-sections.

3.1 Maintenance

Maintenance inspections should occur periodically during the 90 day establishment period. Maintenance visits will assess plant survival/growth and the presence of weeds. Weeds will continue to be controlled as described above in Section 2.5. If installed plant material fails to become established in a given area, appropriately timed remedial planting in accordance with this plan shall be implemented in order to achieve the applicable performance criteria (see Section 3.2).

3.2 Monitoring and Performance Criteria

A restoration biologist or other qualified individual shall inspect the site periodically to track restoration success and identify any remedial action requirements. Qualitative monitoring visits will occur on a bi-weekly basis for the first 90 days following installation and on a quarterly basis thereafter for the 2 year monitoring period. A quantitative monitoring event will occur annually during the summer (see Section 2.9.2). The monitoring and associated performance criteria are summarized in **Table 2**.

3.2.1 Photo-documentation

Digital photographs will be taken from each corner of the construction impact areas in order to cover the entire range of the impact area. Photo-documentation will be completed before remediation activities begin, after revegetation has been completed, and at every annual monitoring visit. The intent of consistent photo-documentation will provide a visual, qualitative assessment of the restoration work.

3.2.2 Percent Cover Monitoring

Annually during mid-summer, percent vegetative cover (native) shall be evaluated using the point intercept method using five 20-meter transects in each impact area. The transects will be randomly located along a baseline established at the discretion of the individual performing the monitoring. The occurrence of native plants, non-native plants, or bare soil will be recorded along each transect at exactly 0.5-meter intervals. Percent cover will be estimated by dividing the total number of “hits” by the total number of points sampled (i.e. 40 points for one 20 meter transect).

During annual monitoring events, the restoration areas shall also be qualitatively assessed for survival of planted species. If monitoring indicates that percent cover performance criteria are not being achieved, replacement plant material should consist of species that have the highest survival rate and most vigorous growth.

3.2.3 Monitoring Reports

Reports will be submitted annually for 2 years following completion of planting. The first report (Post-construction report) shall be submitted approximately 90 days after planting. The annual monitoring report shall be submitted approximately 30 days following the completion of the quantitative vegetation sampling event. Annual monitoring reports shall include methods, results, analysis of results, photo-documentation, discussion of results relative to performance standards/success criteria, and recommended remedial or adaptive management measures if necessary.

Table 2 – Monitoring & Performance Criteria for Salt Marsh Habitat Restoration, IR Site 25

PARAMETER	METHOD OF MONITORING	FREQUENCY AND TIMING	PERFORMANCE CRITERIA	REMEDIAL MEASURE
Avoid impacts to potentially occurring species during collection and harvesting	Inspect site and verify training, field inspections, and protective measures have occurred	During collection, harvesting, planting, and maintenance	Habitat protected from impacts	Increase/replace protective measures
Weed invasion	Qualitative inspections, Percent cover transects	Every 2 weeks during 90 day post-construction period, quarterly thereafter- Annually – Years 1-2 (percent cover)	Limited number of competitive invasive plants. 15% at Year 1; ≤10% Year 2	Hand remove and/or apply herbicide to invasive plants
Planting survival of native plants	Qualitative assessment	Every 2 weeks during 90 days post-construction period Annually - Years 1-2	Visual assessment of plant survival and vigor	Replanting of underrepresented native plant species, replacement of poorly performing native species.
Percent cover of salt marsh plants (Impact Areas)	Percent cover transects	Annually Years 1-2	10 % native cover year 1 25 % native cover year 2	Re-planting of native species as needed. Hand remove and/or apply herbicide to competitive invasive plants

4.0 REFERENCES

Ardea Consulting, Bumgardner Biological Consulting, and Sarah Gordon Ecological Consulting. 2011. Biological Resources Assessment for the IR Site 25, Moffett Federal Airfield, California: dated January 2011.

California Invasive Plant Council. 2006. California Invasive Plant Inventory: Cal-IPC Publication 2006-02, Berkeley, California.

Griffith, K.A. 2010. Pickleweed, Factors that Control Distribution and Abundance in Pacific Coast Estuaries and a Case Study of Elkhorn Slough, California: Elkhorn Slough Technical Report Series 2010-9.

Hickman, J.C. 1996. The Jepson Manual, Higher Plants of California: University of California Press, Berkeley.

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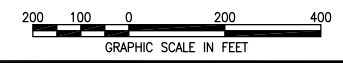
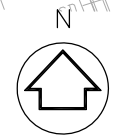


LEGEND

--- APPROXIMATE WETLAND PERIMETER

NOTES:

1. SHADED AREAS ARE PLANNED FOR EXCAVATION.
2. AREAS TO BE RE-VEGETATED ARE INDICATED WITH SQUARE FOOTAGE.



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RD/RAWP	<p>VERIFY SCALE</p> <p>BAR IS ONE INCH ON ORIGINAL DRAWING</p> <p>IF NOT ONE INCH ON THIS SHEET, ADJUST SCALE ACCORDINGLY</p>
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Remedial Action at IR Site 25
 Former NAS Moffett Field
 Moffett Field, California

FIGURE H.1
Re-Vegetation Plan Map